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PRODUCTION TESTS IN PLANT COMMUNITIES OF MEADOW-LAND WITH SOLONETZ SOIL III. ZONE OF AGROSTI-ALOPECURETUM

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Within the framework of the International Biological Programme (MÁTHÉ, 1931), in the area of the village Nagylak in South-East Hungary, we carried out production examinations in meadows of solonetz grass-land soil, in three adjacent zones, in the growing season of 1968 (STEFANOVICS, 1963).

The results of investigations carried out on the stands of the first zone — *Artemisio—Festucetum pseudovinae* (PRÉCSÉNYI, 1969, 1970) — as well as of the middle zone — *Agrosti—Alopecuretum poetosum angustifoliae* — are already published (BODROGKÖZY—HORVÁTH, 1969, 1971). In this paper we are dealing with the results of investigations in the third zone — *Agrosti—Alopecuretum* typicum (SOÓ, 1964).

Vegetation and synecological conditions of the zone

This zone is covered in the winter and spring periods with inland waters flown from areas at higher levels. The remaining of the salt marsh is made possible even after the inland waters (precipitation, downflow) by the high water content. Owing to that, the vegetation is identical with that of the marshy meadows of the typical solonetz grass-land soils, composed mainly of the species components *Agrostion* and *Molinietalia,* being therefore rather poor in species (BODROGKÖZY, 1965).

Our investigations took place in a comparatively drier period than the average one is. In the spring season, level „A" of the soil of this zone contained only 8 per cent water that went on decreasing, later. A considerable rainfall was there only in the second half of summer.

In the *Agrosti—Alopecuretum* typicum, that had a favourable water supply in the other years, the more hydrophilic *Agrostis alba* is dominant and *Alopecurus pratensis* is only second to it in quantity. The stand of this third zone is considerably poorer in species than the marshy meadows of similar type, known from other territories of the country, and the species show a low dominance value during the whole growing season.

The occurring species are mostly glycophilic and not more than one or two halophytes occur by stalks. In the root-zone — i.e., et level „A" of the meadow soil getting solonetz in character, and even at level „B" — the total salt content does not exceed 10 per cent.

The grass-level is of double level. The dominant grass of the first one is *Agrostis alba,* the upper grass-level is formed by *Alopecurus pratensis.*

Results of the investigations

Middle period of the spring aspect. (Investigation: 26 April 1968)

It may be established that, reckoned from March, the beginning of the growing period, the extreme values of temperature did not show any considerable deviation from the average of many years. The number of sunny hours is, however, much higher and the precipitation less than the average of many years. (On this occasion there was no ground examination).

In the spring aspect, *Agrostis alba* is dominant. It is followed by *Alopecurus pratensis* with half a dominance value. The further ten species played a part with a coverage value below 5 per cent.

The dry-matter content of the phyto-mass above the surface, as compared to that of the transitional zone, is considerably lower. In case of *Alopecurus* and *Agrostis* it is about 35 per cent. That of *Eleocharis* is similar to that, as well. The dry-matter content of dicotyledons *(Rorippa kerneri, Rumex stenophyllus,* etc.) is, on the other hand, only 23 to 25 per cent.

In respect of the total carbohydrate concentration, the situation is nearly the same at the grass and the *Eleocharis* belonging to the family Cyperaceae (about 250 gamma/mg). From among the dicotyledons, that of the *Rorippa* is the highest, that of *Rumex* the lowest one.

The concentration of total nitrogen changes between 18—35 gamma/mg. The highest one is that of *Agrostis,* the lowest one that of the dicotyledons generally.

Last period of the spring aspect. (Investigation: 9 May 1968)

In the period between the two investigations, the mean temperature was 2 °C higher than the average of many years and also the number of sunny hours was higher. Owing to the little precipitation; the drought having become permanent since March exerted its effect on the community particularly in this period.

As a result of the increased insolation and little precipitation, the water content of soil has decreased at the lower levels „B" and „C", as well, being 10 per cent on the average.

The salt content has uniformly decreased from the soil surface, being 0.05 per cent at level „A". Below that it increased, reaching 0.2 per cent at level „B_2" (30 cm deep). Therefore, only the layers below 30 cm can practically been considered as solonetz.

The dry-matter content has considerably increased at the most species, particularly at the monocotyledons. The dry-matter content of these became 40—46 per cent. (*Poa angustifolia*). From among the dicotyledons, the dry-matter content of Rorippa silvestris was the highest one (36 p.c.).

The total carbohydrate concentration has generally increased in low degree. From among the species investigated, only *Alopecurus pratensis* was an exception, the total carbohydrate concentration in it having decreased from 260 gamma/mg to 60 gamma/mg.

The total nitrogen concentration has decreased in high degree, particularly at the monocotyledons. That of *Poa angustifolia* was the lowest one: 11 gamma/mg, that of Limonium gmelini the highest one: 16 gamma/mg. In the whole growing period, the difference in the total nitrogen concentration of the species turned out to be the least one in that time.

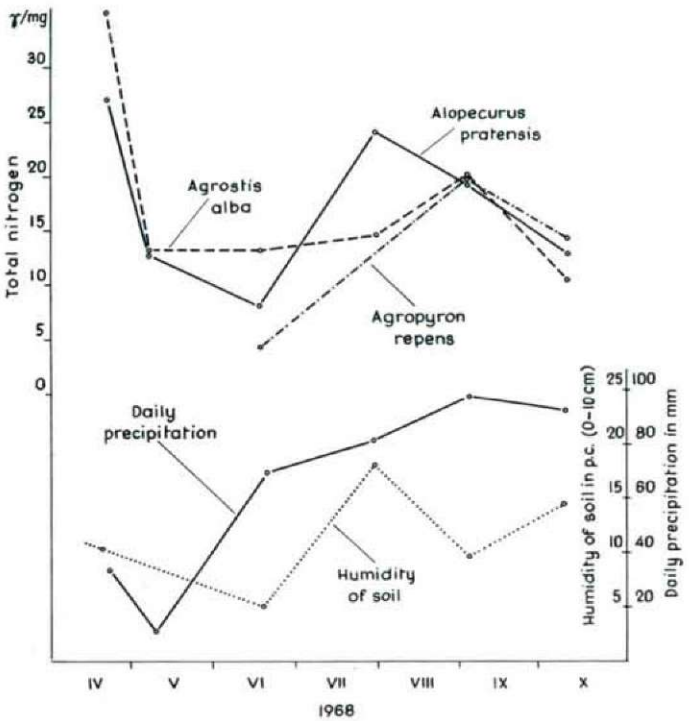


Fig. 1. Correlation between the total nitrogen concentration of the three grass specias and the changes during the growth season in the percental quantity of rainfall nad soil moisture

First period of the summer aspect. (Investigation: 19 June 1968)

The temperature was 1.4 °C higher than the average of many years (13.1 °C), and also the number of sunny hours was higher than the many years' average.

The precipitation is of considerable quantity as compared to the previous period but it falls, anyway, behind the maximum of the June precipitation. The rain falling on four occasions between the two periods investigated did not suffice for moistening the deeper soil layers. The water content of these layers went on decreasing: at levels „A" and „B" it was not more than 5 per cent, reaching only at level „C" 10 per cent.

The total salt content of the soil did not change essentially, as compared to the previous investigation.

The dry-matter content of the monocotyledons went on increasing in a considerable degree, at *Alopecurus pratensis* reaching 75 per cent. At the cotyledons, as well, the increase was general, its degree was, however, highly different in case of the single species. As to the extreme values, at Rumex tenofyllus the value rose from 23 p.c. to 75 p.c., at Rorippa sivestris, on the other hand, it fell from 36 p.c. to 23 p.c.

It can be established that in the growing season the maximum dry-matter content was to be found in that time.

Seen as a whole, a general decrease in the total carbohydrate concentration can be observed, lasting till the end of the growing period. The single species do, however, behave in a divergent manner. At dicotyledons, the change is comparatively of low degree; from the monocotyledons, however, at *Alopecurus pratensis* it is considerable. The total carbohydrate concentration of *Agrostis alba* has increased to a lesser extent.

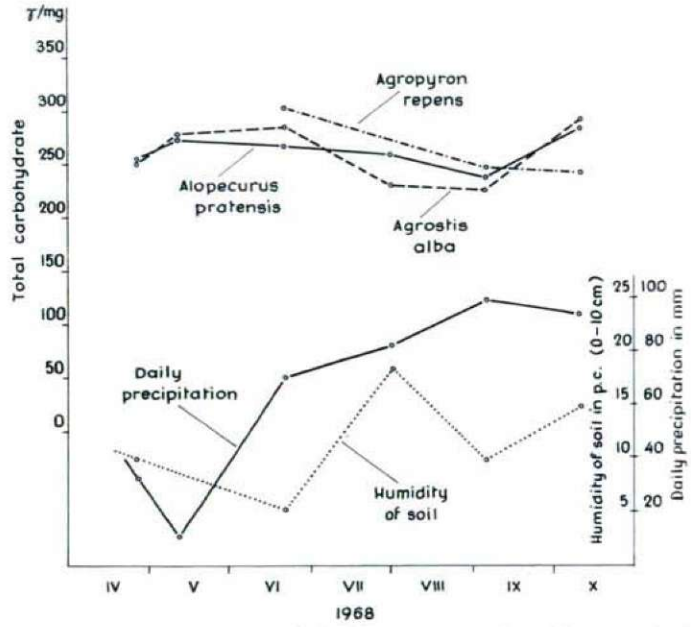


Fig. 2. Correlation between the total carbohydrate concentration changes of the three grass species and the changes of the two external factors

The total nitrogen concentration kept on decreasing, being only in a lesser degree lower than in the previous period investigated. The decrease was considerable only at *Rorippa silvestris:* falling from 11 gamma/mg to 4 gamma/mg. The latter one was, to be sure, the lowest total nitrogen concentration in the whole growing period.

Last period of the summer aspect. (Investigation: 1 August 1968)

In this period of investigation the mean temperature was 20.9 °C, differing — 0.7 °C from the average of many years. The number of sunny hours is compara-

tively low, as a result of the frequent clouding over. The water content of soil was increased by the considerable precipitation partcularly at level „A" (reaching 20 p.c.) but the effect of rainfall appeared till level „C".

As a result of the rinsing effect of precipitation, in the upper soil layers the total salt content has fallen.

The dry-matter content of the species continued decreasing in a general way, particularly in case of monocotyledons. The degree of it was about 20 per cent. From among the dicotyledons, only the dry-matter content of *Limonium gmelini* has increased.

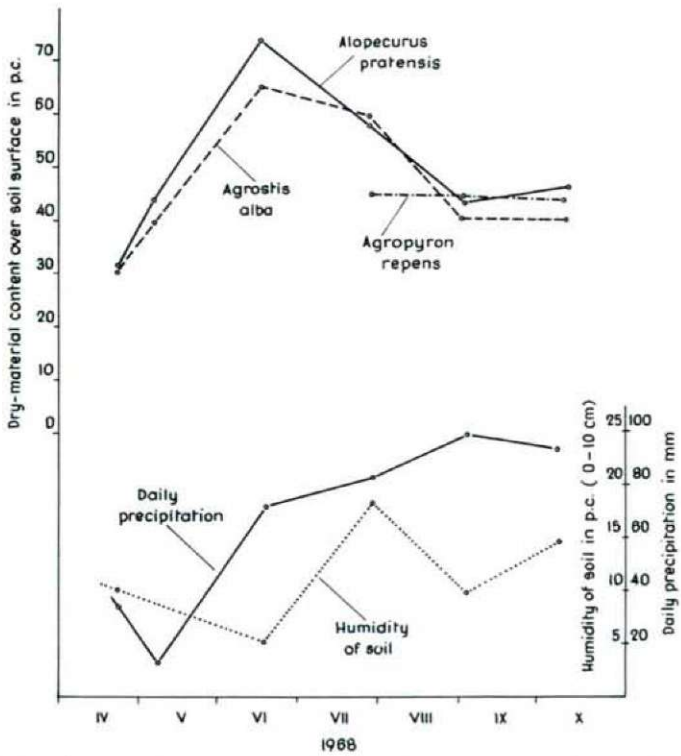


Fig. 3. Correlation between the change in the dry-substance content of the three grass species of the studied species combination and the changes of the value of rainfall and soil moisture

The concentration of total carbohydrate went on decreasing, particularly at monocotyledons. E.g., at *Alopecurus pratensis* it fell from 270 gamma/mg to 200 gamma/mg. The carbohydrate concentration of dicotyledons is only showing a change of lesser extent.

Except *Agrostis alba* — where only a decrease of less degree could be observed — the total nitrogen concentration was going on increasing in a general way. It was of particularly high degree at *Alopecurus pratensis:* from 8

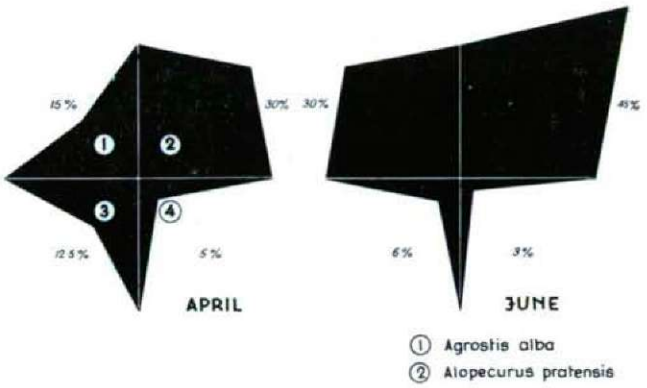


Fig. 4. Qualitative and quantitative changes in the species composition of the stand during the growth season

gamma/mg to 23 gamma/mg. The very high total nitrogen concentration (40 p.c. gamma/mg) of *Taraxacum officinale* may have been a result of some measuring error. It is, at any rate, the highest value at all the species in the whole growing period.

Firs period of the autumn aspect. (Investigation: 5 September 1968)

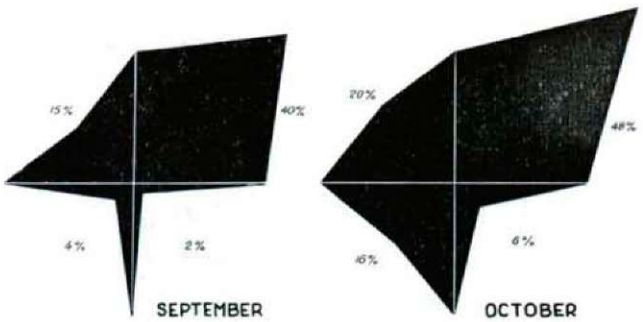
The mean temperature of this period of investigation is 19.4 °C, there are few sunny hours but a considerable amount of precipitation, the distribution of which is uniform. As a result of the increasing transpiration of the augmenting amount of the phyto-mass, however, the water content of soil in the upper layers has decreased.

The dry-matter content of monocotyledons went on decreasing uniformly, and its value is approximately the half part of the maximum in June. (It fell at *Alopecurus pratensis* from 74 p.c. to 42 p.c., at *Agrostis alba* from 72 p.c. to 40 p.c.).

The decrease is general at bicotyledons, as well, but it is not so uniform in degree. It changed, e.g., at *Inula britannica* hardly, on the other hand, at *Mentha pulegium* it fell from 31 p.c. to 26 p.c.

The total carbohydrate concentration at monocotyledons has continued although but in a lower degree. At becotyledons, there wasn't any considerable unequivocal change in this period of investigation, either.

Because of the changes of different directions, the total nitrogen concentration of the species investigated is, similarly to the investigation in May, approximately the same: about 20 gamma/mg. At *Taraxacum,* the total nitrogen concentration is relatively high, at present, too, as compared with the other species.



③ Poa angustifolia
④ Juncus compressus + Dicotyledonopsida

Last period of the autumn aspect. (Investigation: 11 October 1968)

The mean day temperature of the last period of investigation is 15 °C. The number of sunny hours is approximately corresponding to the average of many years. The first third of this period of investigation was the period richest in precipitation, in October, however, there was scarcely any rainfall.

The soil-water content has risen particularly at level „A", reaching 15 per cent.

The total salt content has not shown, in spite of the precipitation, any considerable change. It can be established that, at solonetz meadow soils, the change in „salt profile" in the growing period is unimportant, not being influenced by the precipitation, either.

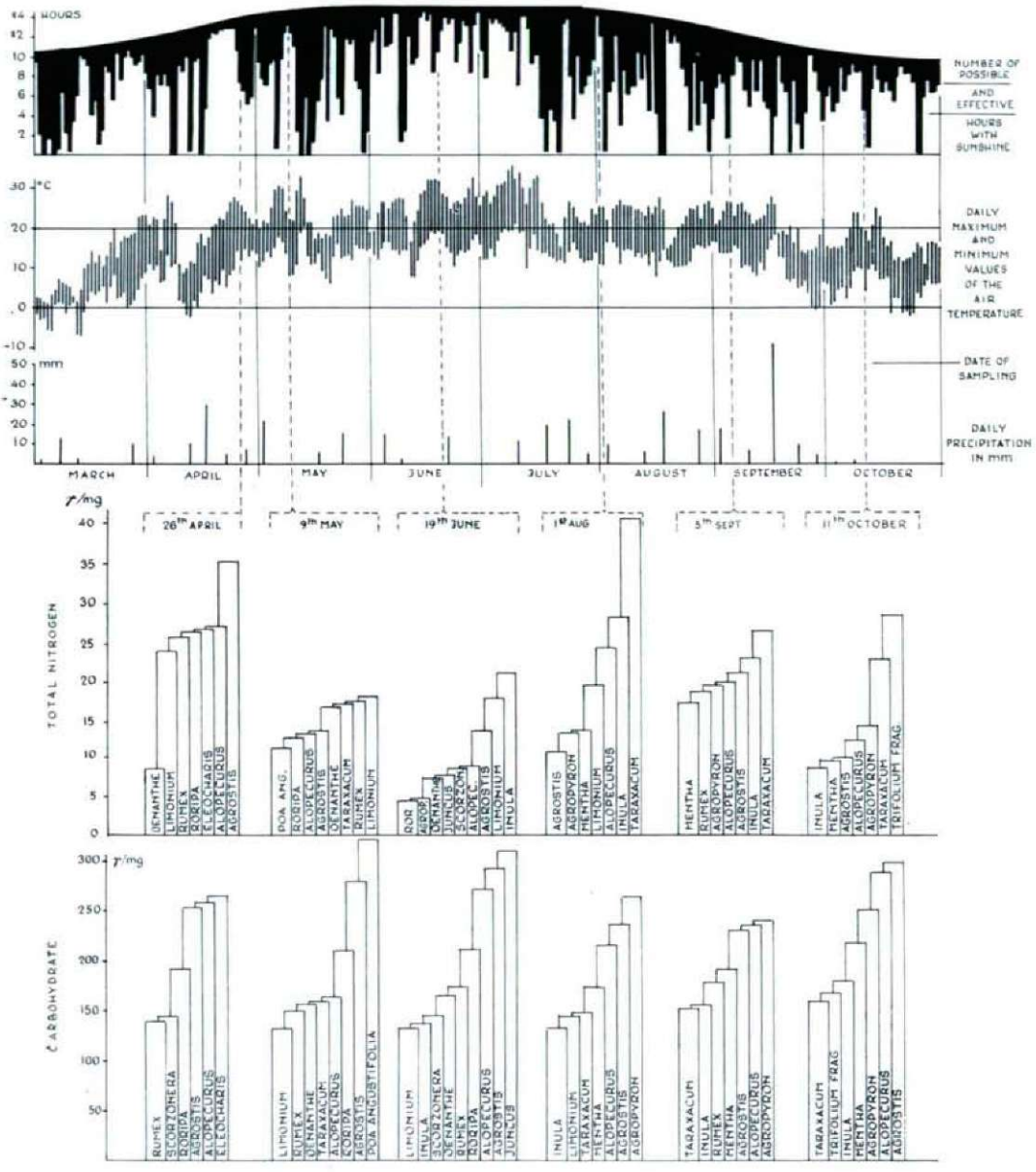
The dry-matter content has scarcely changed, particularly at monocotyledons, as compared with the first investigation.

The total carbohydrate concentration has increased to a high extent at monocotyledons, mainly at *Agrostis alba* (from 230 gamma/mg to 300 gamma/mg), at bicotyledons, however, it has hardly changed.

We have observed a considerable change in the total carbohydrate content both at mono- and bicotyledons. It is, as a result of this decrease, only about 10 gamma/mg, except *Taraxacum officinale* and the re-shooting *Trifolium fragiferum.*

On the basis of our investigations, it can be established that the soil-water content of the zone Agrosti— *Alopecuretum* typicum, mainly at level „A", may be influenced by precipitation in a considerable degree. For instance, as a result of rain fallen in July, the water content in the surface layers was rising from the earlier 5 p.c. to nearly 20 p.c. The soil-water content was considerably influenced by the transpiration of the phyto-mass, as well. We can men-

tion as an example that, in spite of the large mass of precipitation in September, the water content did not rise — owing to the re-shooting — above 15 per cent.



a)

As there is scarcely any connection between the total salt content, precipitation, and phyto-mass, we may draw the conclusion that at the meadow soils of solonetz type the salt content is almost unchanged in the growing period.

The precipitation conditions and the water content of soil is well-followed by the dry-matter content of the most species. In our earlier paper we have referred to that the dry-matter content is showing some connection with the phenological phases, and is the largest in the period of the crop becoming fully ripe. In the zone of *Agrosti—Alopecuretum*-typicum this connection is but of lesser degree, rather the re-shooting having some influence there.

There seems to exist no close connection between the dry-matter content as well as the total carbohydrate and total nitrogen concentrations. The change in total carbohydrate and total nitrogen concentrations is generally contrasted. From among these two indices of inner content, a change in the total carbohyd-

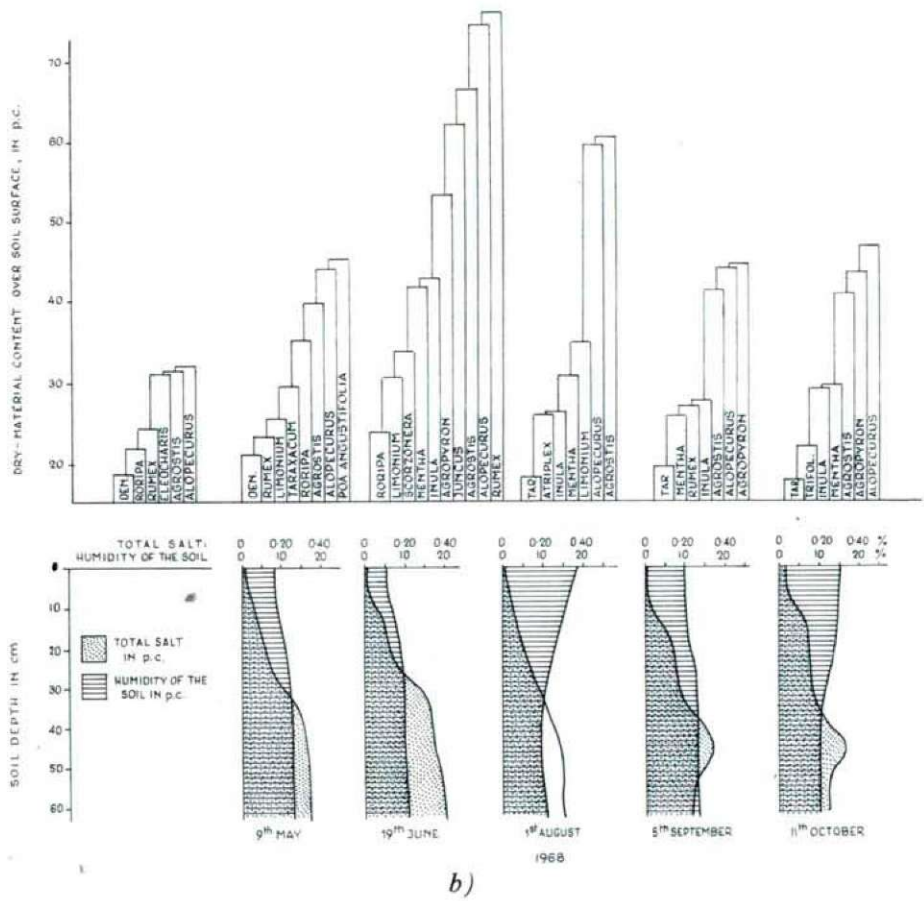


Fig. 5. Changes of the climatic and edaphic factors, and changes in the dry-substance contents, total nitrogen and total carbohydrate concentrations in the species components of the studied phytocenosis during the growth season of 1968

rate concentration is somewhat similar to the course of change in the dry-matter content, only it precedes that and is of considerably smaller degree. We may mention as an example that the extreme value of the dry-matter content in the growing period was 10 p.c. (*Taraxacum officinale* — October), resp. 76 p.c. (*Alopecurus pratensis* — June) and that of the total carbohydrate content was 150 (*Inula britannica* — August), resp. 310 gamma/mg (*Poa angustifolia* — May).

At monocotyledons the concentration of the total carbohydrate, at bicotyledons that of the total nitrogen was higher. The total carbohydrate concentration is the highest at the beginning of the growing period, after that it is falling a little and a new increase is appearing only in the end of the growing period.

The total nitrogen concentration is the greatest at the beginning of the growing period but mainly in the middle of it. The minimum falls to July and October.

The difference between mono- and bicotyledons is greater — as regards the total carbohydrate concentration — than in respect of the total nitrogen concentration. The latter ones were, for instance, on the occasion of the investigation in May approximately identical at almost every species.

Summary

Within the framework of the International Biological Programme the authors carried out synecological investigations in three plant communities of alkali meadows in the area of Nagylak (South-East Hungary). They had dealt already earlier with the results of the zones *Artemisio—Festucetum* pseudovinae and *Agrosti—Alopecuretum poetosum.* They investigated the stand structure, taking into consideration the climatic and edaphic factors, determined the dry-matter content of species, as well as the total carbohydrate and total nitrogen concentrations.

At the beginning of the growing period — and previously, as well — dry and warm crop-land conditions were formed out by weather, the effect of which was increased by the steppelike solonetz meadow soil being saline in the depths. The results of the investigations carried out in the zone *Agrosti—Alopecuretum* typicum can be summed up as follows:

1. The plant community in this zone is poor in species, they have dealt, therefore, first of all with the following species: *Alopecurus pratensis, Agrostis alba, Mentha pulegium, Inula britannica, Taraxacum officinale.*

2. In the soil, in the course of the growing period, some salt accumulation of lower degree took place 20 to 50 cm deep.

3. The water content of the upper 20 cm layer of the soil was influenced by precipitation in a considerable degree till August. Following that, rather an influence of stand and re-shooting was exerted on that. In a layer deeper than 30 cm, the change in water content is of low degree; in the growing period an almost continuous decrease may be observed.

4. The change in dry-matter content, mainly at bicotelydons, is in a close connection with the precipitation and the water-content of soil. As distinguished from the first two zones, the connection with the phenological phases is of lesser degree.

5. Between the dry-matter content as well as the total carbohydrate and total nitrogen concentrations there isn't any close connection.

6. The changes in the total carbohydrate and total nitrogen concentrations are of opposite direction.

7. At monocotyledons the total carbohydrate concentration, but at bicotyledons the total nitrogen concentration is larger.

8. Between the mono- and bicotyledons, the difference in total carbohydrate concentration is larger than in total nitrogen concentration.

9. It can be established on the basis of the dominant *Agrostis alba* that the effect of the soil-water content on the dry-matter content is the strongest in the transitional zone *(Agrosti—Alopecuretum poetosum)* from among the three zones. The difference between the three zones in total carbohydrate concentration is larger than in total nitrogen concentration.

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